REDEFINITION OF THE AUSTRALIAN LEPTODACTYLID FROG *NEOBATRACHUS PICTUS* PETERS

by J. D. ROBERTS*

Summary

ROBERTS, J. D. (1978) Redefinition of the Australian leptodactylid frog *Neobatrachus pictus* Peters. *Trans. R. Soc. S. Aust.* **102**(4), 97-105, 31 May, 1978.

Neobatrachus pictus is redescribed using morphological and male call data. The redescription is based on topotypic material and an examination of syntypes. The geographic range is southern S.A. and Victoria. Most published information about *N. pictus* is based on congeneric species. *N. sudelli* (Lamb) is resurrected from the synonomy of *N. pictus*.

Introduction

Most authors acknowledge that two species of *Neobatrachus* (the type species *N. pictus* Peters and *N. centralis* (Parker)) occur in eastern Australia (Littlejohn 1971; Cogger 1975; Barker & Grigg 1977). However, there is considerable confusion about the identification of individuals to each of these species. For example Cogger (1975) figures the range of *N. pictus* as only just extending into northern Victoria. In contrast Brook (1975) indicates that it is found in almost all of Victoria. Similarly, Barker & Grigg (1977) figured the range of *N. pictus* as extending only peripherally into southeastern South Australia, so excluding the type locality near Adelaide.

Despite Moore's (1961) doubts about the validity of *N. centralis* Littlejohn (1965) provided clear evidence that at least two forms of *Neobatrachus* occur in northwestern Victoria. Littlejohn figured two audiospectrograms: one with a high pulse number, high pulse repetition rate and low dominant frequency was considered to represent *N. centralis*. The other had a low pulse number, low pulse repetition rate and high dominant frequency, and was referred to *N. pictus*. Here I refer to it as "type B". However, South Australian frogs that I refer to *N. pictus* did not make "type B" calls.

The identity of each of these species would be clarified by examination of various data, including male call, from type localities. The type locality of *N. pictus* is near Adelaide, and here I have attempted to redefine this species, and so permit its geographic range to be established.

The type locality

Parker (1940) and Moore (1961) state the type locality of *N. pictus* to be "near Adelaide". Peters' (1864) description was based on material collected by R. Schomburgk of Buchsfelde, "near Adelaide". Buchsfelde is 4.5 km west of Gawler and is now known as Loos (Praite & Tolley 1970).

Richard Schomburgk settled at Buchsfelde in 1849 and lived there or in the Gawler area until at least 1865 (Van Abbe 1960; Serle & Ward 1976). Although there is no direct evidence, it is reasonable to infer that his collection was made at Buchsfelde, and that this is the type locality of *N. pictus*.

Methods

(a) *Material examined:* Calls were analysed from recordings made at seven sites: 7.5 km N.W. of Gawler, i.e. 5.5 km N. of Loos (14 frogs); 15.5 km N.W. of Penola (2 frogs); Semaphore Park, 13 km N.W. of Adelaide (1 frog); Coffin Bay, 38 km W.N.W. of Port Lincoln (1 frog); 7.5 km S. of Kimba (1 frog); Roora Reservoir, Kimba (2 frogs); Pilepudla Reservoir, 17 km N. of Kimba (2 frogs) and Muratchina Dam, 33 km N. of Kimba (1 frog). All recording sites are in

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South Australia and all tape recordings are in my possession.

The following specimens were examined. All are in the S.A. Museum; registration numbers refer to that collection. Collection dates are provided only for topotypes from 7.5 km N.W. of Gawler, all collected by J. D. Roberts.

Topotypic material: R16384 ♀, R16385-R16387 all ♂, all 27.iii.73; R16388 ♂ 2.iv.73; R16389 ♀, R16390-R16394 all ♂, all 5.vi.73. Calls of eight of these males were recorded. Other material: R2590 1 ♂ 1 ♀, Lake Hamilton; R2776 4 ♀, Sellicks Beach; R2888 3 ♂ 1 ♀ 1J, between Naime & Balhannah; R3007 1 ♀, Kangaroo Island; R3099 1 ♀, Muston, Kangaroo Island; R3474 1 ♀, Corny Point; R3482 2 ♀, Kangaroo Island; R3788 1 ♂ 1 ♀, Avenue Range; R4717 1 ♂, Reynella; R5093-5095 3J ,West Beach; R5096 1 ♀, West Beach; R5149 52J, West Beach; R5175 1 ♂ 1 ♀, Naracoorte; R5176 1 ♀, Pt Lincoln; R5195 220J, Cummins; R5196 6J, Hampstead; R5197 1J, Hampstead Gdns; R5497 1 ♀, Mt Graham, nr Millicent; R8355 1J, Hardwicke Bay; R8356 1J, Box Flat, Lameroo; R8844 1 ♂, Edeowie Gorge; R8914 21 ♀ 1J, Naracoorte; R8960 1 ♀, 16 km W. of Vivonne Bay; R8963 1 ♂ 2 ♀, Lucindale; R8970 3 ♂ 2 ♀, Naracoorte; R8977 1J, 9.6 km N.N.E. of Frances; R8986 A-C 3 ♀, Naracoorte; R9974 1 ♂, Hincks Ntl Pk; R10857 1 ♂ 1 ♀, Narrung; R12251 1 ♀, Semaphore Pk; R13039 1 ♀, Nuriootpa; R13345 2 ♀ 1J, Mt Scott Ntl Pk; R13561 1 ♀, Mingbool, nr Mt Gambier; R13623 A-D 2 ♂ 2 ♀, 16-22.4 km S. of Naracoorte; R14256 1 ♀, nr Penola; R15382 3 ♂ 2 ♀ 1J, Bangham Conservation Pk; R15486 1 ♂, Laura; R16017 1 ♀, Innes Ntl Pk; R16129 1 ♀, Sandy Ck Conservation Pk; R16309 1 ♂, Jip Jip Conservation Pk; R16395 1 ♂, 7.5 km N.W. of Gawler; R16396 1 ♂, 9.1 km S. of Kimba; R16397-99 3 ♂, Roora Reservoir, Kimba; R16400 1 ♂, Pilepudla Reservoir, 17 km N. of Kimba; R16401-2 2 ♂, 15.5 km N.W. of Penola; R16403 7 ♂ 2 ♀, 49.1 km N. of Kingston; R16404 1 ♂, 5.3 km N. of Peake; R16405 1 ♂, 32.2 km S. of Mt Mary; R16406 1 ♂ 1 ♀, Yarna Stn, Eyre Peninsula; R16407 1 ♂, 41.6 km N. of Kingston; R16408 1 ♀, 7.0 km S.S.W. of Coolatoo; R16409 1 ♀, 3.5 km S.W. of Coolatoo; R16410 1 ♀, 4.8 km N.W. of Coolatoo; R16411 2 ♂ 1 ♀, 1.6 km S.E. of Mt Barker; R16412 1 ♀, 4.0 km N. of Strathalbyn; R16413 1J, 3.8 km N.N.W. of Littlehampton; R16414 1 ♀, 2.6 km W. of Mt Barker; R16415 7J, 16-32 km S. of Kingston; R16416 2 ♂ 1 ♀, Scorpion Springs Conservation Pk; R16417 1 ♀, 23.5 km N. of Meningie; R16418 2 ♂, Wharminda; R16419 3 ♂ 3 ♀, 24.5 km N. of Kingston; R16420 1 ♂ 1 ♀, Lake Gilles Ntl Pk; R16421 2J, Moody Tanks, W. of Ungarra; R16422 1 ♂, 2.7 km S.E. of Kingston; R16423 1 ♂, Banff; R16424 1 ♀, 4.6 km S.S.W. of Kybybolite; R16425 1 ♂, 0.6 km S.W. of Kybybolite; R16426 1 ♀, 0.3 km N. of Comaum School, Comaum; R16427 1 ♀, 2.5 km S.E. of Glen Roy Rwy Stn; R16428 1 ♂, 16.0 km N.W. of Penola; R16429 1 ♀, 2.5 km S. of Penola; R16430 1 ♀, 13.8 km S. of Penola; R16431 1 ♀, 8.7 km S. of Tarpeena; R16432 1 ♂, Allendale East; R16433 1 ♂ 2 ♀, 26 km N.N.W. of Naracoorte; R16434 7 ♂ 1 ♀, 28.9 km N.N.W. of Naracoorte; R16435 1 ♂ 1 ♀, 5.9 km N.E. of Beachport; R16436 1 ♀, 21.7 km S.E. of Robe; R16437 1 ♀, 5.2 km S.S.W. of Greenways; R16438 2 ♂ 1 ♀, 2.2 km N.E. of Greenways; R16439 1 ♂ 1 ♀, 12.8 km N.E. of Greenways; R16440 1 ♂, 7.5 km E.S.E. of Kingston.

(b) *Call recording and analysis:* Calls were recorded on a Nagra III N.P. tape recorder with Beyer M 100 microphone, a Uher 4400 Report stereo recorder with A.K.G. D 404 C microphone, or a Sony TC-510-2 recorder with A.K.G. D 190 microphone. In all cases tape speed was 19 cm/sec. Recording levels were set below −5dB to minimise overload distortion which could arise with signals of short duration. All recorded frogs were calling from still water. Water temperatures were recorded at the calling site, but may slightly overestimate cloacal temperatures. For fifteen frogs where both data are available the mean difference between water and cloacal temperatures was 0.16°C. This difference was significant (Wilcoxon T 6.5, $P < .05$). However, as only water temperature data were obtained in some cases this problem cannot be overcome.

Tape recordings were analysed by playback at half speed on the recorder used for field recording, with the output displayed on a Tektronix 502 double beam oscilloscope and photographed by a Grass C4 camera. A time marker (100 pulses/sec, derived from the 50 Hz mains frequency) was displayed on the second beam of the oscilloscope. With half speed playback the time marker effectively represents 5 m sec. rather than the expected 10 m sec. intervals.

Only the last clear recorded call was analysed for each frog. Successive calls of individual frogs were similar. Pulse repetition rate was measured from pulses 7 to 10 and pulse duration, dominant frequency and rise time (i.e. the time from start to peak pulse amplitude) were measured in pulses 7, 8 and 9 and the three values averaged. Pulses per call were counted in the last three recorded calls (either from oscillograms or by playback at reduced tape speed), and the three values averaged.

(c) *Geographic distribution and biology:* Distribution data were collated in three ways:

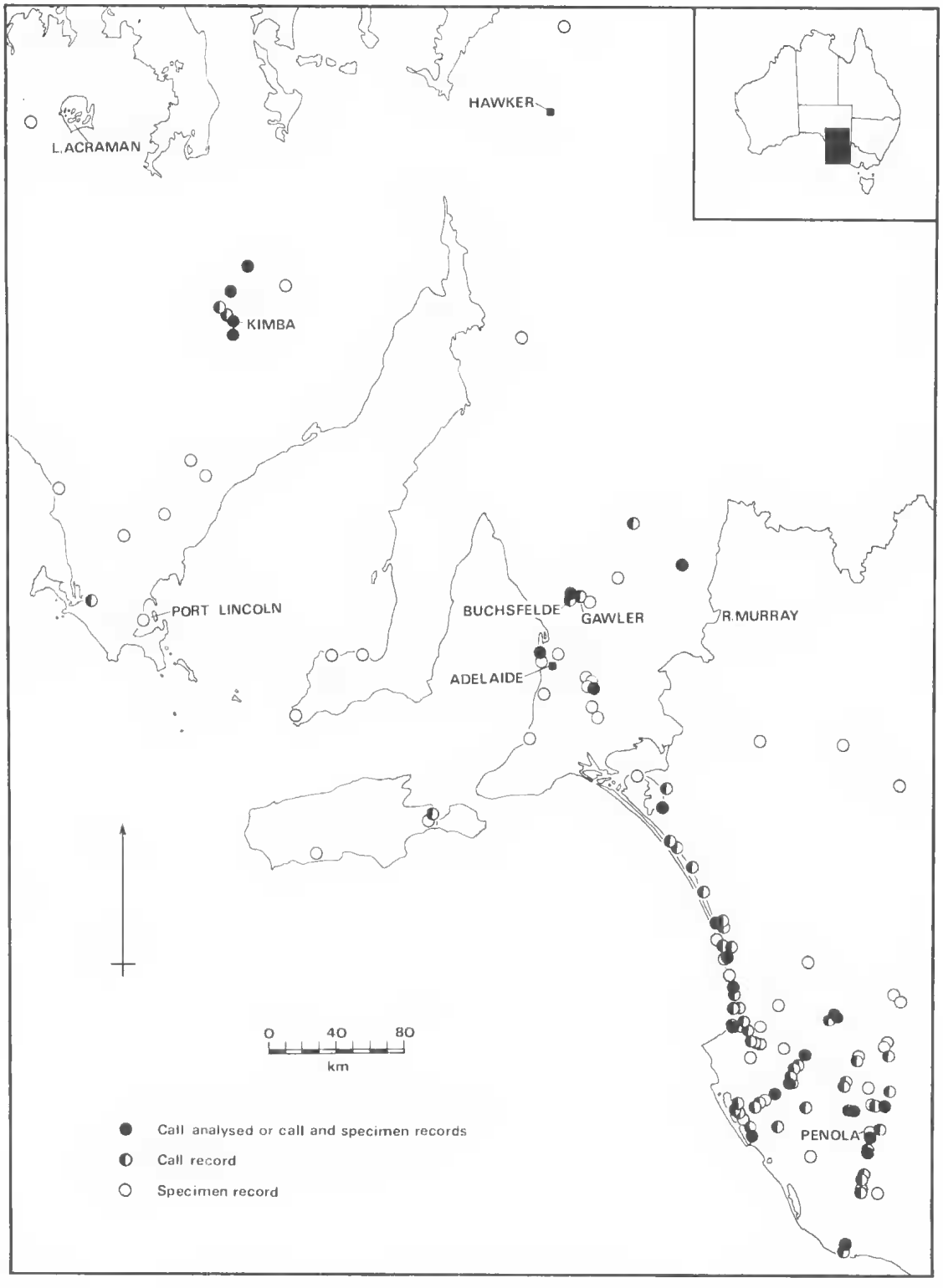

Fig. 1. Distribution of *Neobatrachus pictus* in S.A.

TABLE 1

Temperature effects on call component values. Temperature range 8.5–22.0°C; sample size 14. Significance of regression coefficients was compared with 0. (n.s. not significant, * p <.05, ** p <.01, *** p <.001).

Call Component	Slope	S.E.	Intercept
Pulses/Sec.	1.188**	.078	1.249
Pulse Rise Time	—0.136***	.026	5.635
Pulse Duration	—0.287*	.100	16.313
Dominant Frequency	0.011*	.004	1.139
Mean Pulses/Call	—0.473 n.s.	.370	40.098

TABLE 2

Call component values and standard errors at 15°C for temperature dependent components. Sample mean and standard error for pulses/call.

Call Component	Value	S.E.	Range
Pulses/Sec.	19.01	.397	–
Pulse Rise Time (msec.)	3.60	.117	–
Pulse Duration (msec.)	12.00	.444	–
Dominant Frequency (kHz)	1.30	.019	–
Mean Pulses/Call	33.07	1.323	23.7–43.3

from detailed analyses of field recorded calls; by subjective evaluation of choruses heard in the field (call records, Fig. 1), and by examination of specimens collected without call data and held in the S.A. Museum (see p. —). Observations on general and particularly breeding biology were made during field recording trips.

(d) *Morphology:* I made a detailed examination of 11 specimens (9 ♂, 2 ♀, see Topotypic material listed above) collected 7.5 km N.W. of Gawler, and the syntypes of *N. pictus*. The following body dimensions were recorded: snout-vent length; head length (from tip of snout to posterior tip of jaw articulation); head width (measured behind eyes between tips of jaw articulation; eye length (horizontal distance from anterior corner of eye to anterior edge of naris); tibia length (measured with leg flexed so that bone fitted inside calipers).

Fig. 2. Upper, oscillogram of complete call of male (R16393) recorded 7.5 km N.W. of Gawler on 5.vi.1973. Lower, detail of pulse structure in pulses 7–8. In both cases the lower trace is a time marker representing 5 msec. intervals. Call starts on right.

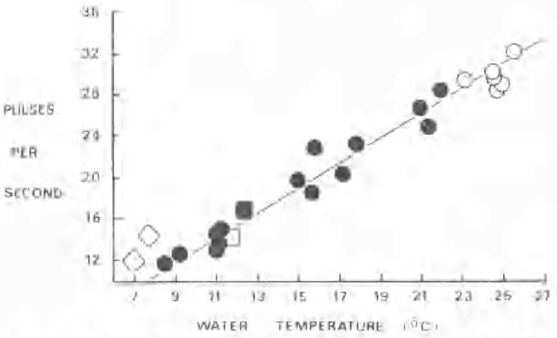

Fig. 3. Geographic variation in pulse repetition rate values. Solid circles: Gawler; open circles: Kimba area; open diamond: Penola; open square: Semaphore Pk; solid square: Coffin Bay. (See *Material Examined* for specific locality data.)

Less detailed examinations were also made of numerous frogs from localities throughout S.A.

Results

(a) *Calls:* For the Gawler sample all call component values were regressed on water temperature; the results of this analysis are given in Table 1. Only the average number of pulses/call is not influenced by temperature. Mean call component values (at 15°C, estimated from the regression lines for temperature dependent variables) are given in Table 2. A representative oscillogram is illustrated in Figure 2.

The call of *N. pictus* can be characterised by a high pulse number (33), low dominant frequency (1.3 kHz) and a high pulse repetition rate relative to other *Neobatrachus* calls known from South Australia (Roberts, unpublished observations). Pulses are short (12 msec.) and have a smooth rise and decay cycle (Fig. 2). Peak pulse amplitude rises slowly for the first few pulses then evens out (Fig. 2).

Calls analysed from other sites in South Australia closely resemble calls from Gawler, and there is no evidence of significant geographic variation in any call components (Fig. 3 illustrates this for pulse repetition rate).

The call Littlejohn (1965) considered to represent *N. centralis* is similar to calls from Gawler, and it is likely that in reality these

individuals represent *N. pictus*. The identity of frogs he referred to *N. pictus* is therefore uncertain.

The calls described above are characteristic of males calling strongly. At the start of calling sequences males sometimes make calls with much lower pulse numbers. However, such calls have a pulse form, pulse repetition rate and dominant frequency as detailed above.

(b) *Geographic distribution:* The known range of this species in South Australia is given in Figure 1. The species occurs throughout the southern portion of the State, extending north to Edeowie Gorge (40 km N.N.E. of Hawker, S.A.M. R8844), west to Yarna Station near Lake Acraman, northern Eyre Peninsula (S.A.M. R16406) and east to the Victoria border.

Near Morgan and Blanchetown on the River Murray, and north from Kimba on Eyre Peninsula, *N. pictus* is replaced by another species (possibly *N. centralis*) differing in call and morphology. Near Naracoorte and Penola *N. pictus* occurs sympatrically with a congeneric species which can be distinguished by male call but less reliably by morphology. Calls of all these frogs are the "type B" of Littlejohn (1965).

I have no data on the distribution of *N. pictus* outside South Australia. However, Brook (1975) gave data on the distribution of *Neobatrachus* in Victoria, partly derived from field notebooks of Littlejohn and his coworkers. If Brook adopted Littlejohn's call nomenclature (see above), his records of "*N. centralis*" almost certainly refer to *N. pictus*. This species therefore extends into western Victoria, and in some sites is sympatric with a congeneric form.

The density of records on Figure 1 reflects the intensity of field investigation in various areas, and not necessarily the density of *N. pictus*. I have had little opportunity to work in mid-northern South Australia but have spent a considerable amount of time in the southeast of the State.

(c) *Biology: N. pictus* only breeds after heavy rain (usually more than 25 mm in 24 hr) and probably breeds at any time of year. I have observed breeding and calling activity in February, March and throughout winter and early spring. Breeding periods are short and rarely last more than a few days. Breeding aggregations are often dense. In July 1972, near Kingston, I observed more than 150 frogs in an area of about 225 m^2.

Males generally call while floating in water with the head above the surface but with the rest of the body submerged. Calling sites vary from exposed situations to sites where the male is completely concealed under flooded vegetation. Males often move when calling. Occasionally they call from very shallow water with only the ventral surface submerged.

Males are not discriminating in their choice of mates, and I have observed males trying to amplex other males, spent females and even moist rabbit dung on the pond margin. Amplectant pairs are quite often found on land apparently heading for breeding pools. Amplexus is inguinal.

Breeding sites are usually shallow, temporary pools, though breeding may occur in dams. I have never observed *N. pictus* calling or breeding in flowing water. The eggs are pigmented and deposited in large clumps or in long strands several eggs wide. Initially the eggs are stuck together with jelly, but egg masses soon break down and the clearly encapsulated eggs sink to the bottom of the pond.

I have no data on larval biology or morphology though Martin (1965), Tyler (1966) and Watson & Martin (1973) all give illustrations of the mouthparts and some other details. However, Martin's (1965) and Watson & Martin's (1973) data are from specimens outside the known range of *N. pictus*, and thus may refer to some other, related species.

Though *N. pictus* is encountered most commonly when breeding, individuals are often active on moist evenings, and I have found them on roads and around swamps, and other sites that may be used for breeding. This species burrows and I have found individuals buried hard against the underside of large stones. I have no data on other burying sites.

(d) *Morphology:* These data are presented as a redescription of *N. pictus*.

Neobatrachus pictus Peters

Neobatrachus pictus Peters 1864 *Monatsb. K. Preuss. Akad. Wiss. Berlin* 1864, 228.

Heleioporus pictus: Boulenger 1882 *Cat. Batr. Sal. Brit. Mus.* ed. 2, 272.

Definition: A moderate to large species of robust habitus. Limbs short, large inner metatarsal tubercle invariably with a black cutting edge. Dorsal skin, particularly on the anterior half of body, covered with numerous, fine,

TABLE 3
Proportions of 11 *N. pictus* from near Gawler.

Ratio	Mean	Range
Head width/Head length	1.22	1.16–1.35
Eye/Eye–naris	1.55	1.33–1.82
Eye–naris/Internarial span	1.00	0.83–1.14
Head length/Snout–vent length	0.35	0.33–0.39
Tibia length/Snout–vent length	0.34	0.25–0.38

Fig. 4. *Neobatrachus pictus*, Comaum, S.A.

small warts which are spinose in breeding males. Distinguished from related species either by its large size, distinctive call or, lack of a skin connection from the knee across the groin to the side of the body.

Description: Head high, wider than long and roughly one third of snout-vent length (Table 3). Snout rounded when viewed from above and angled slightly posteriorly in profile. Nares dorsal and, when viewed from above, closer to end of snout than to eye. Internarial span greater or less than eye to naris distance (Table 3). Canthus rostralis slightly rounded. Eye large and prominent, its diameter about one and one half times eye to naris length (Table 3). Pupil a vertical slit; iris covered with fine dark veins on, in life, a golden background (Fig. 4). Tympanum not visible externally but present and roughly circular. Vomerine teeth divided medially; their posterior margin in line with posterior margin of choanae. Vomerine teeth in close contact medially, or slightly divided and may be in a straight series or with lateral ends angled slightly towards snout. Tongue ovoid to circular; covers most of floor of the mouth. Attached closely anteriorly but posterior and lateral margins free.

Fingers short and cylindrical. No interdigital webbing; all fingers fringed, the fourth least (Fig. 5a). Dark brown to black nuptial pads well developed on first and second fingers of breeding males, extending from base of each finger to at least ultimate joint. Pads extend underneath base of first finger (Fig. 5a) but only occur on medial side, and medial upper half of second. In some specimens there is fine extension of pad past ultimate joint on both fingers. Dark, finely spinose material of nuptial pad may be lost in preserved specimens and underlying, calloused area is difficult to distinguish. Finger lengths usually $3 > 1 > 2 > 4$; rarely $1 = 2$. Subarticular tubercles well developed and irregular number of interdigital tubercles. Tubercles at base of second and third fingers often divided. Generally two large, flat palmar tubercles: that at base of first finger more prominent. Nuptial pad may over-

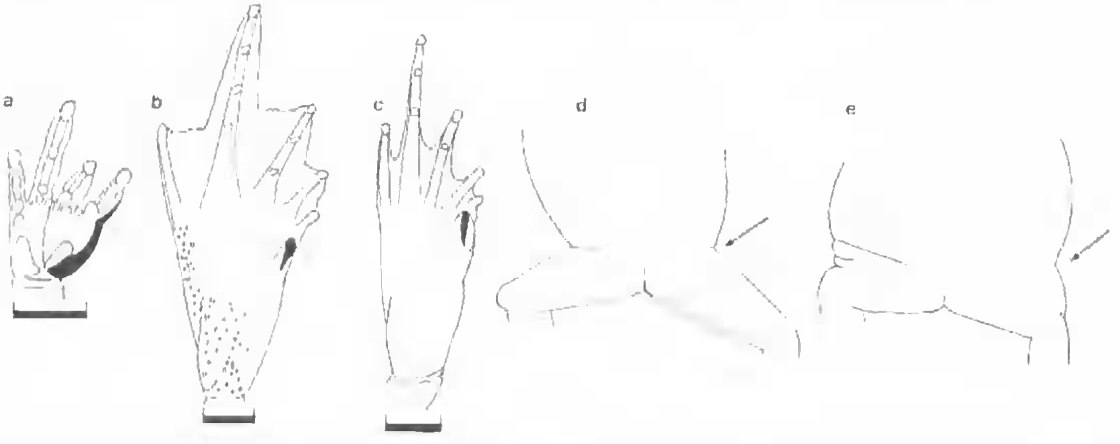

Fig. 5. a. Right hand of male (R16393); b. Right foot of male (R16391); c. Right foot of female (R16389); d. Groin of *N. pictus* (R16393); e. Groin of male making "type B" calls from 8 km W. of Blanchetown (R16449). In d. and e. arrow indicates area of difference. In a. b. and c. the bar represents 5 mm.

lap medial edge of inner palmar tubercle (Fig. 5a).

Hind limbs short with tibia averaging one third of snout-vent length (Table 3). Toes short and cylindrical with order of lengths 4 > 3 > 5 > 2 > 1. On one foot of R16399 toe 5 > 3. Subarticular tubercles poorly developed and may not be obvious on fifth toe. No outer metatarsal tubercle but large, shovel shaped, inner metatarsal tubercle, usually edged with black or rarely light brown. Blackened section always much longer than maximum width and symmetric about mid line (Fig. 5b, c). In males, webbing between toes extensive, extending to or beyond ultimate joint, with distinctive almost rectangular indentation between third and fourth, and fourth and fifth toes (Fig. 5b). At tip of fifth toe webbing may appear almost as fringe. In females webbing much less extensive, reaching only to second joint on fourth toe, and deeply indented between all toes (Fig. 5c).

Ventral surface, top of foot, femur and underside of arm smooth. Dorsal surface, head and eyelids, upper side of arms, tibia and underside of foot usually bear numerous, fine, smooth warts. On posterior half of dorsum warts may only occur in band down mid-line. In breeding males numerous small, short, sharp black spines. Cloacal region bears fine white granules. Just above jaw (extending back to above arm) there may be roughly linear series of large white granules, occasionally fusing to form fairly distinct stripe.

Ventral surface white; mandibular margins or whole chin may be lightly suffused with grey or light brown. In preservative dorsal surface varies from light to dark grey with numerous small to medium darker spots. Edges of spots usually diffuse. There may be a narrow, white to cream mid-dorsal stripe, often interrupted. Of the eleven specimens from near Gawler, three had no stripe, three a clear stripe and five an interrupted stripe. In life, background colour is generally a yellowish green with spots dark brown to black.

The eleven specimens from near Gawler had an average snout-vent length of 45.7 mm (40.5–52.0 mm).

Geographic variation: Frogs from all parts of the range in S.A. vary only in the following respects: in a series of males from and near Kimba the foot webbing is much less extensive, and closer to that in females from Gawler (Fig. 5c). In males from Penola the webbing is more extensive but through southeastern S.A. males have more extensive webbing than females. Some of this variation may be seasonal as reported for *N. pelobatoides* (Parker 1940).

In some specimens, particularly from the Mt Barker-Balhannah area of the Mt Lofty Ranges, as well as a mid-dorsal stripe there was an elongate V-shaped mark extending posteriorly from above the arm with the point of the V in line with the eye. In a few frogs from southeastern S.A. and the Mt Lofty Ranges the tip of the first toe bears a light brown to black spot.

The maximum snout-vent lengths recorded were 62.6 mm (♂ R16416, Scorpion Springs Conservation Pk) and 60.7 mm (♂ R10857, Narrung).

Call: Relatively long, averaging 33 pulses (19 pulses/sec. at water temperature of 15°C). Dominant frequency 1.3 kHz.

Comparison with other species: The call of *N. pictus* clearly distinguishes it from congeners known from S. Other *Neobatrachus* encountered all had similar calls with higher dominant frequencies (from 1.5–1.7 kHz), low pulse numbers (average about 15) and at any given temperature a much lower pulse repetition rate than *N. pictus;* my "type B" call of Littlejohn (1965).

Adults of these other call types are either much smaller (average S–V 36 mm) with large, clearly demarcated spots on the dorsal surface (southeastern S.A.) or are light brown or golden coloured with skin extending from the side of the body across the groin to the knee (Fig. 5e) (northern, northeastern and northwestern S.A.). In *N. pictus* skin only extends marginally along the upper leg from the side of the body (Fig. 5d). The skin enclosed groin also occurs in the small form in southeastern S.A., but is not a constant feature of these frogs.

Type specimens

There are five syntypes in the Zoologisches Museum, Humboldt University: 9507, a subadult (? female) of 31.3 mm, and a juvenile ? *Notaden melanoscaphus;* 4725 a partly decomposed adult female of 45.0 mm and a poorly preserved male of 41.8 mm; 4726 a well preserved gravid female of 55.1 mm S–V and 56.4 mm (total length measured to posterior extremity of body beyond the vent. It is clear from the size and other details that Peters based his description on No. 4726. It

agrees with the original and this description in size and all other pertinent respects.

Discussion

The distribution data in Figure 1 combined with Brook's data for western Victoria probably represent the total range of this species. As *N. pictus* is replaced to the west, northwest, north and northeast in S.A. and to the east in Victoria (Brook 1975) by "call type B" frogs, the only possible extension is into southern and eastern N.S.W. Barker & Grigg[1] recorded "type B" calls 24 km S. of Condobolin, N.S.W., attributing them to *N. pictus*. If their use of the name *N. pictus* is consistent throughout the range they give for this species (central N.S.W. as far as Queensland and south into Victoria) then there is little chance that *N. pictus* (sensu stricto) occurs anywhere in N.S.W. or Queensland.

Previous redescriptions of *N. pictus* (Parker 1940; Moore 1961) differ from mine in several details. However, the character most profitably used in distinguishing *N. pictus* from *Neobatrachus* making "type B" calls (extent of skin in the groin: Fig. 5d, e), was not considered by either author. The differences between my description and those of these authors may reflect the fact that in all probability none of the specimens examined by them are conspecific with *N. pictus*. Parker examined material from Melbourne and Sandhurst (= Bendigo, Reed 1973) in Victoria, Urana and Ryalstone in N.S.W. and a skeleton from "Australia". Moore's description seems to be largely based on specimens collected at Mt Stromlo, A.C.T. If my interpretation of the range of *N. pictus* is correct, none of these sites fall within the range of this species.

The distribution data I have presented show clearly that *N. pictus* occurs on the Eyre Peninsula. Main, Lee & Littlejohn (1958), Cogger (1975) and Barker & Grigg (1977) have failed to recognise this fact. Furthermore this species is not yet known to occur in N.S.W., and published ranges extending across N.S.W. and into Queensland (Cogger 1975; Barker & Grigg 1977) are likely to be in error.

Heleioporus sudelli Lamb (1911) from Warwick, Queensland has been considered a synonym of *N. pictus* (Hosmer 1958; Moore 1961) though Parker (1940) expressed doubts. Because I have established that *N. pictus* does not occur in Queensland, this synonomy cannot be sustained. Thus I resurrect *N. sudelli* (Lamb) as a valid species, and possibly a senior synonym of *N. centralis* (Parker).

The relationships of *N. pictus* to congeners is unclear. Parker (1940) argued that *N. pelobatoides* is the western analogue of *N. pictus*, and that these two species are closely related: a sentiment reiterated by Main, Lee & Littlejohn (1958) and by Littlejohn (1967). However, as Parker's concept of *N. pictus* is now suspect the real relationships are more obscure. This problem will only be resolved following a thorough re-examination of material from all over Australia, variously referred to *centralis*, *pictus* and *sudelli*. The status of *Neobatrachus* populations making "type B" calls in S.A., N.S.W. and Victoria should be included in such a review.

Acknowledgments

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To the above and to the numerous persons who either sent specimens or recordings my sincere thanks.

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